

## CLAIMS

1. A multilayer printed wiring board comprising:
  - (a) an inner layer material comprising
    - 5 an insulating substrate,  
a plurality of inner conductive patterns, each of said plurality of inner conductive patterns is formed of a metal foil disposed on both sides of said insulating substrate, respectively, and  
an interstitial via hole disposed on said insulating substrate;
    - (b) an insulating resin disposed on both sides of said inner layer material, respectively;
    - (c) an outer conductive pattern adhered on said insulating resin; and
    - (d) a surface via hole to connect electrically between said inner 15 conductive pattern and said outer conductive pattern,
  - wherein said interstitial via hole connects electrically between respective inner conductive pattern of said plurality of inner conductive patterns, and
  - 20 said outer conductive pattern is formed of a metal foil of a metal foil with insulating resin, said metal foil with insulating resin comprising said insulating resin and said metal foil adhered to said insulating resin.  
  2. The multilayer printed wiring board according to Claim 1,  
wherein said insulating substrate is formed by hardening a sheet 25 like resin prepreg, said sheet like resin prepreg including a base material and a resin impregnated to said base material,  
said insulating substrate has a through hole,  
said interstitial via hole has a conductive paste that is filled in said through hole,  
30 said insulating resin has a non-through hole, and  
said surface via hole is formed in said non-through hole.

3. The multilayer printed wiring board according to Claim 1,  
wherein said surface via hole has a metal plating applied to said  
non-through hole.

5           4. The multilayer printed wiring board according to Claim 1,  
              wherein said surface via hole has a metal plating applied to said  
              non-through hole, and  
              said conductive pattern for outer layer further has a metal plating  
              disposed on a surface of said conductive pattern for outer layer.

10           5. The multilayer printed wiring board according to Claim 2,  
              wherein said resin contained in said insulating substrate includes  
              a same material as said insulating resin.

15           6. The multilayer printed wiring board according to Claim 2,  
              wherein said resin contained in said insulating has a thermoset-  
              ting resin, and  
              said base material is formed of aromatic polyamide and has in-  
              compressibility and a porous structure.

20           7. The multilayer printed wiring board according to Claim 2,  
              wherein said base material has a nonwoven fabric formed of aro-  
              matic polyamide fibers.

25           8. The multilayer printed wiring board according to Claim 1,  
              wherein at least one of said non-through hole and said through  
              hole ranges from about 30  $\mu\text{m}$  to about 100  $\mu\text{m}$  in diameter.

30           9. The multilayer printed wiring board according to Claim 1,  
              wherein said non-through hole and said through hole are formed  
              by laser beam machining.

10. The multilayer printed wiring board according to Claim 1,  
wherein said inner layer material comprises a plurality of insulating substrates, and each of said plurality of inner conductive patterns is disposed, respectively, on both sides of said each respective insulating substrate.

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11. A multilayer printed wiring board comprising:

- (a) an inner layer material comprising  
an insulating substrate,

10 an inner conductive pattern formed of a metal foil disposed on both sides of said insulating substrate, respectively, and

an interstitial via hole disposed on said insulating substrate;

15 (b) an insulating resin disposed on both sides of said inner layer material, respectively;

(c) an outer conductive pattern disposed on a surface of said insulating resin; and

(d) a surface via hole to connect electrically between said inner conductive pattern and said outer conductive pattern,

20 wherein said outer conductive pattern is formed of a metal foil of a metal foil with insulating resin, said metal foil with insulating resin comprising said insulating resin and said metal foil adhered to said insulating resin,

said inner conductive pattern further comprises a conductor projection connected electrically with said inner conductive pattern,

25 said conductor projection pierces through said insulating substrate and is connected to said outer conductive pattern, and

said conductor projection serves a function of said interstitial via hole.

30 12. The multilayer printed wiring board according to Claim 11,

wherein said insulating substrate is formed by hardening a sheet like resin prepreg, said sheet like resin prepreg comprising a base

material and a resin impregnated to said base material,  
said conductor projection pierces through said resin prepreg,  
said insulating resin has a non-through hole, and  
said surface via hole is formed in said non-through hole.

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13. The multilayer printed wiring board according to Claim 11,  
wherein said non-through hole is formed by laser beam  
machining.

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14. The multilayer printed wiring board according to Claim 11,  
wherein said conductor projection is formed by hardening  
a conductive paste.

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15. The multilayer printed wiring board according to Claim 11,  
wherein said conductor projection is shaped like at least one  
configuration selected from a cone and a pyramid.

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16. The multilayer printed wiring board according to Claim 11,  
wherein said surface via hole has a metal plating applied to said  
non-through hole.

17. The multilayer printed wiring board according to Claim 12,  
wherein said surface via hole has a metal plating applied to said  
non-through hole, and

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said outer conductive pattern further has a metal plating dis-  
posed on a surface of said outer conductive pattern.

18. A manufacturing method of a multilayer printed wiring board  
comprising the steps of:

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(a) preparing an inner layer material,  
said inner layer material comprising  
an insulating substrate,

an inner conductive pattern formed of a metal foil disposed on both sides of said insulating substrate, respectively, and

an interstitial via hole disposed on said insulating substrate;

5       (b) superimposing a metal foil with insulating resin on both surfaces of said inner layer material, respectively, said metal foil with insulating resin formed of an insulating resin and a metal foil adhered to said insulating resin;

10      (c) applying a pressing force to said inner layer material and said metal foil with insulating resin superimposed on each of both surfaces of said inner layer material while heat being applied thereto, thereby allowing said insulating resin to be attached by adhesion on said inner layer material;

     (d) forming a non-through hole on said metal foil with insulating resin by having said metal foil with insulating resin worked on;

15      (e) forming an outer conductive pattern by having said exposed metal foil worked on; and

     (f) connecting electrically between said outer conductive pattern and said inner conductive pattern.

19. The manufacturing method of a multilayer printed wiring board  
20 according to Claim 18,

wherein a method for preparing said inner layer material comprises the steps of:

(i) forming a through hole in a sheet like resin prepreg comprising a base material and a resin impregnated to said base material,

25      (ii) filling a conductive paste in said through hole,

     (iii) superimposing a metal foil on both sides of said resin prepreg having said conductive paste, respectively,

30      (iv) applying a pressing force to said resin prepreg having said conductive paste with said metal foil superimposed thereon while heat being applied thereto,

thereby forming said insulating substrate as a result of hardening of said resin prepreg,

joining said insulating substrate and said metal foil together by adhesion and

forming said interstitial via hole as a result of hardening of said conductive paste, and

5 (v) forming said inner conductive pattern by having said metal foil worked on.

20. The manufacturing method of a multilayer printed wiring board according to Claim 19,

10 wherein said through hole and said non-through hole are formed by laser beam machining.

21. The manufacturing method of a multilayer printed wiring board according to Claim 19,

15 wherein said step of forming said non-through hole comprises the step of:

eliminating in advance said metal foil located on an area where said non-through hole is to be formed; and

20 forming said non-through hole at a position where said metal foil is eliminated.

22. The manufacturing method of a multilayer printed wiring board according to Claim 18,

25 wherein said step of connecting electrically between said outer conductive pattern and said inner conductive pattern includes a step of applying a metal plating to said non-through hole.

23. The manufacturing method of a multilayer printed wiring board according to Claim 18,

30 wherein said step of forming a non-through hole on said metal foil with insulating resin further comprises the steps of:

eliminating said metal foil in an area where said non-through

hole is formed; and

forming said non-through hole by irradiating a laser beam having a diameter larger than a diameter required of said non-through hole in said area where said metal foil is eliminated.

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24. The manufacturing method of a multilayer printed wiring board according to Claim 19,

wherein said resin contained in said insulating substrate and said insulating resin of said metal foil with insulating resin are same with  
10 each other.

25. The manufacturing method of a multilayer printed wiring board according to Claim 19,

15 wherein said resin contained in said insulating substrate includes a thermosetting resin, and

said base material is formed of aromatic polyamide and has incompressibility and a porous structure.

26. The manufacturing method of a multilayer printed wiring board  
20 according to Claim 19,

wherein said base material has a nonwoven fabric formed of aromatic polyamide fibers.

27. The manufacturing method of a multilayer printed wiring board  
25 according to Claim 18,

wherein said step of connecting electrically between said outer conductive pattern and said inner conductive pattern further comprises the steps of:

30 applying a metal plating to said non-through hole; and

applying a metal plating on a surface of said outer conductive pattern.

28. The manufacturing method of a multilayer printed wiring board according to Claim 19,

wherein at least one of said non-through hole and said through hole ranges from about 30  $\mu\text{m}$  to about 100  $\mu\text{m}$  in diameter.

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29. The manufacturing method of a multilayer printed wiring board according to Claim 18,

wherein said step of forming said inner layer material includes a step of forming a plurality of insulating substrates and a plurality of inner conductive patterns, each of plurality of inner conductive patterns is disposed, respectively, on both sides of said each respective insulating substrate.

30. A manufacturing method of a multilayer printed wiring board comprising the steps of:

15 (a) preparing an inner layer material,

said inner layer material comprising  
an insulating substrate,

an inner conductive pattern formed of a metal foil disposed on both sides of said insulating substrate, respectively, and

20 an interstitial via hole disposed on said insulating substrate;

(b) superimposing a metal foil with insulating resin on both surfaces of said inner layer material, respectively, said metal foil with insulating resin comprising an insulating resin and a metal foil adhered to said insulating resin; ;

25 (c) applying a pressing force to said inner layer material and said metal foil with insulating resin superimposed on each of both surfaces of said inner layer material while heat being applied thereto, thereby allowing said insulating resin to adhere to said inner layer material;

(d) forming a non-through hole on said metal foil with insulating resin by having said metal foil with insulating resin worked on;

30 (e) forming a outer conductive pattern by having said exposed metal foil worked on; and

(f) connecting electrically between said outer conductive pattern and said inner conductive pattern,

wherein a method for preparing said inner layer material comprises the steps of:

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(i) disposing a conductor projection on a first metal foil;

(ii) forming a resin prepreg comprising a basic material and a resin, with which said basic material is impregnated;

(iii) superimposing said metal foil with said conductor projection on one surface of said resin prepreg, and superimposing a second metal foil on another surface thereof; and

10 (iv) applying a pressing force to said first metal foil, said insulating substrate and said second metal foil that are stacked on top of one another while heat being applied thereto,

15 thereby having said resin prepreg pierced with said conductor projection,

forming said insulating substrate as a result of hardening of said resin prepreg and

20 forming said interstitial via hole with said conductor projection.

31. The manufacturing method of a multilayer printed wiring board according to Claim 30,

wherein said conductor projection is shaped like at least one configuration selected from a cone and a pyramid.

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32. The manufacturing method of a multilayer printed wiring board according to Claim 30,

wherein said non-through hole is formed by laser beam machining.

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33. The manufacturing method of a multilayer printed wiring board according to Claim 30,

wherein said step of connecting electrically between said outer conductive pattern and said inner conductive pattern includes a step of applying a metal plating to said non-through hole.

- 5        34. The manufacturing method of a multilayer printed wiring board according to Claim 30,

      wherein said resin contained in said insulating substrate includes a thermosetting resin, and

- 10      said base material is formed of aromatic polyamide and has in-  
            compressibility and a porous structure.

35. The manufacturing method of a multilayer printed wiring board according to Claim 30,

- wherein said non-through hole ranges from about 30  $\mu\text{m}$  to  
15      about 100  $\mu\text{m}$  in diameter.